Journal of the Royal Society of Arts

NO. 4925 FRIDAY, 14TH MAY, 1954 VOL. CII

FORTHCOMING MEETINGS

MONDAY, 17TH MAY, AT 6 p.m. The first of three CANTOR LECTURES on '*The Chemistry of Leather*', by Henry Phillips, D.Sc., F.R.I.C., Director, The British Leather Manufacturers' Research Association. (The syllabus for these lectures, which are illustrated with lantern slides, was published in the last issue of the *Journal*.)

TUESDAY, 18TH MAY, AT 5.15 p.m. COMMONWEALTH SECTION. '*Engineering Developments in Central Africa*', by Sir William Halcrow, M.I.C.E., M.I.Mech.E. Sir Gilbert Rennie, G.B.E., K.C.M.G., M.C., High Commissioner for the Federation of Rhodesia and Nyasaland, will preside. The paper will be illustrated with lantern slides. (Tea will be served from 4.30 p.m.)

WEDNESDAY, 19TH MAY, AT 2.30 p.m. ALFRED BOSSOM LECTURE. '*The Design of New Schools*', by C. H. Aslin, C.B.E., F.R.I.B.A., County Architect, Hertfordshire County Council. Sir Griffith Williams, K.B.E., C.B., a Member of Council of the Society and late Deputy Secretary, Ministry of Education, will preside. The lecture will be illustrated with lantern slides.

MONDAY, 24TH MAY, AT 6 p.m. The second of three CANTOR LECTURES on '*The Chemistry of Leather*', by Henry Phillips, D.Sc., F.R.I.C.

TUESDAY, 25TH MAY, AT 5.15 p.m. COMMONWEALTH SECTION. '*Progress Towards the Eradication of Leprosy from the British Commonwealth*', by Major-General Sir Leonard Rogers, K.C.S.I., C.I.E., M.D., F.R.C.P., F.R.S. Sir Selwyn Selwyn-Clarke, K.B.E., C.M.G., M.C., M.D., F.R.C.P., Chairman of the Commonwealth Committee, will preside. The paper will be illustrated with lantern slides. (Tea will be served from 4.30 p.m.)

MONDAY, 31ST MAY, AT 6 p.m. The last of three CANTOR LECTURES on '*The Chemistry of Leather*', by Henry Phillips, D.Sc., F.R.I.C.

THE SOCIETY'S BICENTENARY: TWO FURTHER EVENTS

THE CHAIRMAN AND LADY RADNOR 'AT HOME'

The Chairman and Lady Radnor have expressed a most kind wish to invite a limited number of Fellows and their wives to visit their home, Longford Castle, near Salisbury, on the afternoon of Saturday, 3rd July. Longford Castle contains, besides its many art treasures and features of general interest, numerous relics of the Society's first President, the first Viscount Folkestone.

Fellows who would like to receive an invitation are asked to inform the Secretary of the Society *not later than Saturday, 5th June*, stating whether they wish to be accompanied by their wife or husband. A ballot will be held, if necessary, and a formal card of invitation will be sent shortly after 5th June to those who are successful.

The Secretary will be pleased to reserve seats and obtain reduced fares for those travelling by train from Waterloo. Transport will be provided from Salisbury Station to and from Longford Castle. Full details will be sent with the cards of invitation.

SOIRÉE AT THE SOCIETY'S HOUSE

An informal reception will be held at the Society's House on the evening of Wednesday, 30th June, to provide an opportunity for Fellows to see the cinematograph film which is being made of the Bicentenary celebrations and to hear parts of the recording of the music at the Thanksgiving Service at St. Martin-in-the-Fields. The congratulatory addresses presented to the Society will again be on view, and also the large number of still photographs which were taken of the various functions. Dress will be dinner jackets.

Fellows who would like to be present are asked to notify the Secretary *as soon as possible*, as arrangements will be made for a second reception if the numbers justify such a course. Each Fellow attending may bring a guest if he so desires.

This soirée is, of course, in addition to the more formal reception, which is to be held at St. James's Palace in the autumn, and the revised date for which it is hoped to announce shortly.

MEETING OF COUNCIL

A meeting of Council was held on Monday, 10th May, 1954. Present: The Earl of Radnor (in the Chair); Mr. F. H. Andrews; Sir Alfred Bossom; Sir Frank Brown; Sir Edward Crowe; Sir John Forsdyke; Mr. P. A. Le Neve Foster; Mr. John Gloag; Dr. R. W. Holland; Sir Harry Lindsay; Mr. F. A. Mercer; Mr. O. P. Milne; Lord Nathan; Sir William Ogg; Mr. E. M. Rich; Mr. A. R. N. Roberts; Sir Andrew Rowell; Mr. E. Munro Runtz; Mr. Gordon Russell; Sir Harold Saunders; Sir Selwyn Selwyn-Clarke; Sir John Simonsen;

Professor Dudley Stamp; Mr. William Will; Sir Griffith Williams; Mr. J. G. Wilson; Sir John Woodhead, and Miss Anna Zinkeisen; with Mr. K. W. Luckhurst (Secretary) and Mr. R. V. C. Cleveland-Stevens (Assistant Secretary).

ELECTIONS

The following candidates were duly elected Fellows of the Society:

Adkins, Bertram, Sutton, Surrey.
Altrincham, The Right Honble. Lord, P.C., K.C.M.G., K.C.V.O., D.S.O., London.
Baskerville, Reginald Ernest, Hornchurch, Essex.
Beaufoy, Leroy Arthur, M.Sc., Ph.D., M.I.Mech.E., A.M.I.C.E., London.
Beeby-Thompson, Arthur, O.B.E., M.I.Mech.E., London.
Blinkhorn, Bernard Laxton, Parkstone, Dorset.
Boath, John Sutherland Ross, D.A., Aberfeldy, Perthshire.
Boden, Leonard, London.
Bradbury, Duncan, Stanmore, Middx.
Buckley-Saxon, James Bramley, London.
Carter, Professor Charles Frederick, M.A., Belfast, Northern Ireland.
Chance, John Wybergh, B.A., Penn, Bucks.
Clifford, Thomas William, M.I.Mech.E., Leicester.
Coetzer, Willem Hermanus, Johannesburg, South Africa.
Cohen, Ronald Julian, M.A., Guildford, Surrey.
Connell, Anthony Murdoch, B.A., Manchester.
Cooper, Edward Eugene, Melbourne, Victoria, Australia.
Coote, Frederick Stanley, Hong Kong.
Coote, John George Prime, London.
Corfiato, Professor Hector O., F.R.I.B.A., F.S.A., S.A.D.G., London.
Davis, John Richard, London.
Davis, Reginald Montagu, London.
Dennes, Professor William Ray, M.A., D.Phil., LL.D., Berkeley, California, U.S.A.
Dodding, Herbert Midgley, Brighouse, Yorks.
Flowerdew, Leonard James, B.Com., London.
Goodman, Bruce Wilfred, A.C.A., London.
Griffiths, Tom, Norwich, Norfolk.
Grumbacher, Stanley, New York City, New York, U.S.A.
Henson, Arthur Edward, F.R.I.B.A., London.
Holley, Burton Duncan, B.Sc., Downers Grove, Illinois, U.S.A.
Howorth, Miss Muriel, L.R.A.M., London.
Hughes, Mrs. Helen MacGill, M.A., Ph.D., Chicago, Illinois, U.S.A.
Jones, J. R., Hong Kong.
Kenworthy, Alan, Crawley, Sussex.
Marshall, George Edward, A.T.D., Llanelly, Carms.
Masters, John Yelf, Melbourne, Victoria, Australia.
Mott, George Robert, West Bridgford, Notts.
Nobbins, Arthur Edward, Hong Kong.
Paniker, K. C. Sankara, Egmore, Madras, India.
Parlanti, Conrad Anthony, Lenzie, Lanark.
Parry, Albert Sydney Arnold, Liverpool.
Pritchard, John Robert, Birmingham.
Sieff, Israel Moses, B.Com., London.
Sieff, Joseph Edward, London.
Sieff, Colonel Marcus Joseph, O.B.E., London.

Sinclair, Archibald, M.A., Ed.B., Glasgow.
Spencer, Commander John, R.N., London.
Stokes, George William, M.I.Struct.E., Welwyn Garden City, Herts.
Stoneham, Edward George, A.C.I.I., Reigate, Surrey.
Sykes, Mrs. Pauline M., Huddersfield, Yorks.
Tomkinson, Michael Wilfred, Claines, Worcs.
Vaughan, Professor Reginald Charles, B.Sc., A.M.I.C.E., Hong Kong.
Williams, Eric Sleeman, Stockport, Cheshire.
Wong, Cho-Tang, Singapore.

The following candidate was duly elected an Associate Member of the Society:

Harris, Miss Margaret Rachel, Newton-le-Willows, Lancs.

ALBERT MEDAL

Further consideration was given to the award of the Albert Medal for 1954 and a name selected for submission to His Royal Highness the President.

BALLOTING LIST

The preparation of the balloting list for the new Council was completed.

It was also decided to set up a Committee to consider a possible simplification of the procedure for elections to the Council.

ANNUAL GENERAL MEETING

It was decided that the Annual General Meeting should be held on Wednesday, 30th June.

EXAMINATIONS

It was reported that the total number of entries for the Whitsun examinations was 42,763, as compared with 39,952 in 1953.

ROYAL HORTICULTURAL SOCIETY

Lord Radnor was appointed to represent the Society at the sesquicentenary celebrations of the Royal Horticultural Society and to convey the Society's congratulations and good wishes.

OTHER BUSINESS

A quantity of financial and other business was transacted.

THE EVOLUTION OF PUBLIC HEALTH ENGINEERING

A paper by

F. E. BRUCE, M.Sc., S.M., A.M.I.C.E.,

Reader in Public Health Engineering, Imperial College of Science and Technology, read to the Society on Wednesday, 3rd February, 1954, with G. M. McNaughton, C.B., B.Sc., M.I.C.E., Chief Engineer, Ministry of Housing and Local Government, in the Chair

THE CHAIRMAN: I expect that, before I call on Mr. Bruce to present his paper, you would like me to tell you something about your lecturer.

He is a product of London University and, after graduation there, he went for a number of years into the municipal service in this country. In the Second World War he served in the fighting forces for approximately six years. Afterwards he returned to municipal service for a short period, and then went to Harvard University, where he graduated in sanitary engineering under that famous professor of engineering, Gordon Fair. On his return to this country, he was appointed Lecturer in Public Health Engineering to the City and Guilds, and last year he was appointed Reader.

It has been my personal privilege to collaborate with Mr. Bruce in work connected with public health engineering which has been sponsored by the World Health Organization in Geneva and the Rockefeller Foundation. I have found him co-operative and most efficient, and a learned colleague in that work. Only recently he conducted, on behalf of United Nations, an engineering survey in villages in Northern Greece with a view to providing them with piped water supplies.

I have told about your lecturer, and I now have much pleasure in asking him to present his paper.

The following paper, which was illustrated with lantern slides, was then read:

THE PAPER

When the Council of the Royal Society of Arts honoured me with an invitation to present a paper on the history and achievements of sanitary engineering, they reminded me of the words of the Chief Medical Officer to the Ministry of Health in his Annual Report for 1951, when he said: 'We are leaving the era of sanitary engineering and are entering into that of personal hygiene in which each person must definitely contribute to the common weal'. I propose to comment on that statement towards the end of this paper, but in introducing my subject I should like to explain the title which I have adopted.

First, the term sanitary engineering, despite its etymological correctness as a synonym for health engineering, has come to be generally used in a sense

restricted to water supply and sewage disposal, especially in relation to buildings. To many people, indeed, sanitary engineering means little more than 'the drains'. However, engineering principles are applied in many other ways to the promotion of public health, and the term public health engineering is being increasingly used when this wider application is in mind.

Secondly, one short paper could hardly do justice to the long and absorbing history of such a subject, and I have therefore attempted merely to trace the development of one or two of the elements which are of outstanding importance in building up the complex science of public health engineering.

THE ANCIENT CIVILIZATIONS

Although modern sanitation is a development of the last two hundred years, it is interesting, and perhaps salutary, to remind ourselves that many of the ancient civilizations attained high standards in the creation of healthy cities. Most of their achievements were lost to the world until revealed by excavation during the last hundred years or so, and we do not know—and probably never shall—the full extent of their skill.

The great palace of Knossos in Crete, a product of the Minoan civilization which lasted from 4000 to 1400 B.C.—nearly half as long again as the Christian era—is perhaps the finest example. Here have been found the remains of elaborate sanitary works, including piped water supplies, luxurious baths, water closets flushed in the modern style and a complicated drainage system. When the wonders of this palace were unearthed in the early years of this century a French scholar, admiring the centuries-old representation of Cretan ladies on a frieze at Knossos, exclaimed, '*Mais ce sont des Parisiennes*!' An Italian, equally impressed by the drainage system, hailed it as 'absolutely English'. Sir Leonard Woolley says: 'We see the elaborate drainage system of Knossos and at once feel at home'.

The Indus civilization, twenty-five centuries before Christ, built houses with baths and lavatories on the upper floors drained through terra-cotta pipes with spigot and socket joints to sewers in the streets. There were also rubbish chutes emptying into bins outside the houses, a built-in refinement which rarely, if ever, figures in the modern estate agent's advertisements.

The necessity for purifying water to make it fit to drink was also felt. The ancient Egyptians used the principle of sedimentation to clarify water, and the method of siphoning off the clear liquid is illustrated on the walls of tombs in the fifteenth century B.C. Filtration through sand and gravel was practised in India two thousand years before Christ, and the value of boiling water to make it keep was well appreciated. Perhaps the most ingenious example of water treatment—if it can be so-called—was the drinking cup reputed to have been designed by Lycurgus of Sparta in the ninth century B.C. This was credited with causing mud to stick to its sides and—probably the more important of its functions—it hid any colour or dirtiness in the water from the sight of the drinker. I make no comment on the fact that Lycurgus was not an engineer but a lawyer.

The Romans were great engineers, and they were also deeply interested in physical fitness and bodily health. The marrying of these two interests led to the construction of the famous aqueducts, by which Rome and other cities were supplied with pure water from mountain springs many miles distant, the great sewers, the baths, the cleverly heated and ventilated houses and open-air schools. Indeed, the Romans went far beyond the supply merely of the necessities of life. Their increasing love of comfort and luxury was a material factor contributing to the decay and fall of their Empire. Some may see in this a warning for our own civilization.

COLLAPSE AND REBUILDING

With the fall of the Roman Empire Europe lapsed into a truly dark age when hygiene and cleanliness were of no account and disease roamed unchecked. Religious teaching held that the body was to be despised, and it has been said of this period that 'witches were boiled instead of water'.

From about the thirteenth century onwards, however, we witness a slow and laborious re-establishment of the art of living in cities. As populations grew and trade developed, it became necessary to enact laws to regulate behaviour so that a man did not make himself a nuisance to his neighbours. Thus we find acts and local statutes prohibiting such offences as the throwing of refuse into streets and watercourses, the keeping of pigs and the flaying of dead horses. There was, of course, very little idea of the protection of public health about these measures. Their aim was to prevent inconvenience and offence, though we may well imagine that the standard set for the definition of a medieval nuisance would be very much inferior to our own. Noses were no doubt less sensitive in those days.

On the positive side there was gradual progress in the supply of water to towns, often by means of open channels or leats, such as the one built in 1591 by Sir Francis Drake at Plymouth, which continued in use for three hundred years, or Sir Hugh Myddleton's New River, which still carries water for London. Pipes, usually of wood or lead, were used in many towns for the distribution of water. Sewers were built to carry off surface water, but they must also have carried much of the refuse and mud from houses and streets.

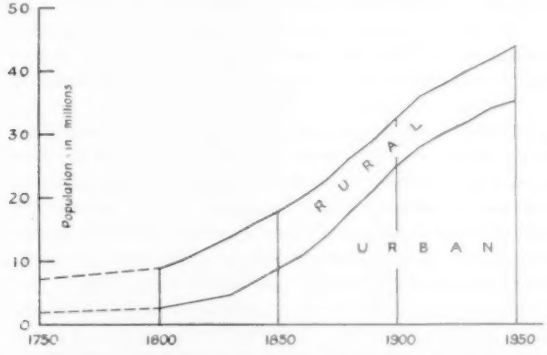
THE INDUSTRIAL REVOLUTION

The invention of the steam engine and the introduction of mechanical power into manufacturing processes formed a turning point in the history of the world which needs no elaboration here. It affects our story in two ways. One is through the growth of new engineering techniques. The other is through the rapid transformation in the living habits of millions of people in the more advanced countries, and especially in Britain, by which many of the already existing hazards to health were intensified beyond any previous experience.

In 1801 when the first census was taken, England and Wales had a population of just under nine millions, of whom less than 30 per cent lived in urban areas. In the middle of the eighteenth century, therefore, when the Industrial Revolution

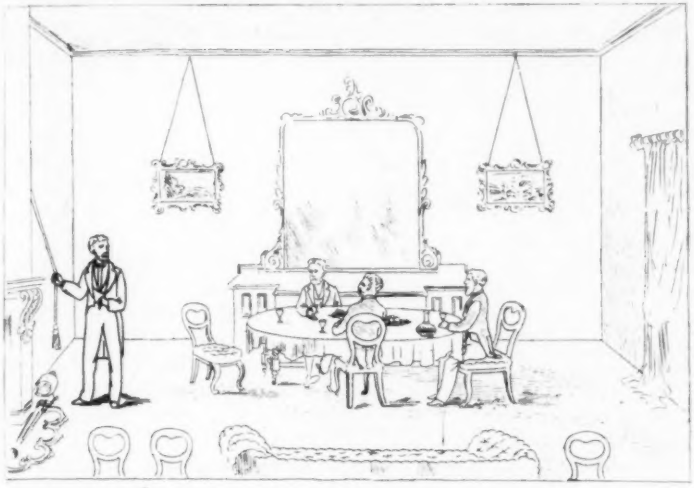
was beginning, the number of town-dwellers was probably less than two millions. A century later the total population was eighteen millions, of whom nearly ten millions lived in urban areas. This five-fold increase in the number of town-dwellers led to an appalling congestion in the industrial areas of the country. The lack of transport meant that the workers were herded together as close as possible to their work, living in ill-built, insanitary hovels where there was often no way of disposing of household and human wastes, and water was drawn from shallow wells with no protection against pollution. The engineer John Phillips, who made a survey for the Metropolitan Commission of Sewers in 1847, recorded his impressions thus:

> There are hundreds, I may say thousands, of houses in this metropolis which have no drainage whatever, and the greater part of them have stinking, overflowing cesspools. And there are also hundreds of streets, courts and alleys that have no sewers; and how the drainage and filth are cleaned away, and how the miserable inhabitants live in such places, it is hard to tell.
>
> In pursuance of my duties from time to time, I have visited very many places where filth was lying scattered about the rooms, vaults, cellars, areas and yards, so thick and so deep that it was hardly possible to move for it. . . . The effects of the effluvia, stench, and poisonous gases constantly evolving from these foul accumulations were apparent in the haggard, wan, and swarthy countenances and enfeebled limbs of the poor creatures whom I found residing over and amongst these dens of pollution and wretchedness.

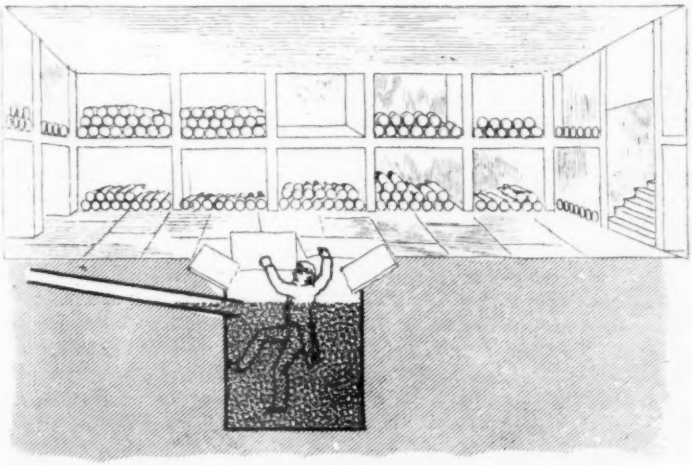


Urban and rural populations of England and Wales, 1750–1950

Reliable records of the incidence of disease and of the causes of death did not become available until the Registration Act of 1836 came into force. But communicable diseases, especially the excremental and filth diseases, such as typhoid, dysentery and typhus, must have taken a very heavy toll in such conditions. When cholera, spreading across the world from its endemic focus in India, attacked England in 1831, 1848 and 1854, it found ideal conditions for its dissemination, and caused panic in the overcrowded slums of the towns.



More wine wanted. Where is the butler?



"A lower deep,
Still threatening to devour me opens wide."—MILTON.

Even the wealthy had cesspool troubles in the nineteenth century. An illustration from Dangers to Health, *by T. Pridgin Teale (4th Edition, 1883), reproduced by permission of Messrs. J. and A. Churchill*

It is not surprising that as the pressure in the towns increased the conscience of the country was stirred, particularly after the ravages of cholera had been experienced. It was a sluggish conscience, drugged by a sense of the overwhelming magnitude of events, and by ignorance of just what was wrong and what could be done to put things right. But the age brought forth a number of humanitarian philosophers and reformers who saw that the poor need not live in such squalor, and who were not afraid to agitate for official action to remedy the situation.

John Howard led the way with his painstaking investigation into the conditions in prisons, especially with regard to ventilation. Jeremy Bentham, James Mill and John Stuart Mill developed their philosophy of government, the aim of which was summed up as 'the greatest happiness of the greatest number'. The doctors Southwood Smith, Arnott, Kay and John Simon studied and reported on many aspects of health and social conditions. But the man who provided the driving force that was necessary to move public opinion was Edwin Chadwick, a disciple of Bentham. Not only did he proclaim that something must be done, but he spared no effort to convince others that it could be done, and went to great lengths to devise the means for doing it.

In his Report on the Sanitary Conditions of the Labouring Classes, published in 1842, Chadwick, after thorough personal enquiry into existing conditions, put his finger on the prime essentials for the improvement of public health as being a good water supply, the carrying away, below ground, of all human excreta, and the prompt removal of all refuse of habitations and streets. He insisted that, in the interests of efficiency and economy, responsibility for the design and construction of all new works for the public health should be placed in the hands of properly qualified civil engineers. He was, however, rather ahead of many civil engineers of the time, at least in the matter of sewerage.

Most existing sewers were designed primarily to carry off rainwater to the nearest watercourse, and were built in brick or stone of such a size that they could be entered by men for cleaning and maintenance. In London it was illegal until 1815 to connect house drains to these sewers, and in other towns such connections were prohibited until later dates. Thereafter, when house connections were made to existing sewers, the latter, because of their size, flat gradients and sluggish flow, became nothing but 'elongated cesspools' or 'sewers of deposit'. Chadwick saw that if the foul matter were to be washed right away from the houses, sewers must be made smaller and steeper, and ample water must be provided to keep the sewers flushed clean all the time.

Chadwick, like Lycurgus, was a lawyer by training, not an engineer. But there was no cheating here. He did not hesitate to plunge into the technicalities of the design of sewers and to stand up to the engineers in bitter controversy over the merits of small clay pipes as opposed to large brick sewers. He even conducted experiments on the flow of water through pipes to support his arguments. The first earthenware pipes in the country were made at his instigation, and he had to face much derision when the early pipes failed through weakness and irregularity of size and composition. Nevertheless, he fought

stubbornly, and his ideas eventually won the day. Nowadays earthenware pipes flowing at self-cleansing velocities constitute the bulk of nearly every town sewerage system.

It may not be out of place at this point to recall that Edwin Chadwick, who, more than any other single man, initiated the era of sanitary engineering, was for forty-three years a member of the Society of Arts, and served as a Vice-President for eight years. He was a frequent contributor to its discussions and to the *Journal* on sanitation and the many other causes with which his name is associated.

Chadwick did not neglect the complementary problem of water supply, for his sewers needed a continuous supply of water at a good pressure, instead of the poor, intermittent supplies that were available in a few fortunate areas. His contribution here was more to the political and administrative problems involved than to the technical development of water supply.

The outstanding technical development in the period had taken place some years earlier, in 1829, when, after some forty years of experiment with many different forms of construction, notably in France, Scotland and Lancashire, the first successful sand filter was put into operation by James Simpson, engineer to the Chelsea Water Works. Filtration became necessary owing to the deterioration in the quality of rivers as the paving and sewering of towns progressed and more and more refuse and sewage flowed into the streams. The Thames was in a particularly parlous state, owing to the size to which London had grown. Until the middle of the century all London's water intakes from the Thames were within the tidal portion and drew in a mixture of river water, untreated sewage and factory wastes. The experience of the Chelsea Water Company led other companies to introduce filtration to remove visible dirt and render the water more palatable. Under the Metropolis Water Act, 1852, filtration was made compulsory and the companies were also required to move their intakes to the cleaner non-tidal portion of the river.

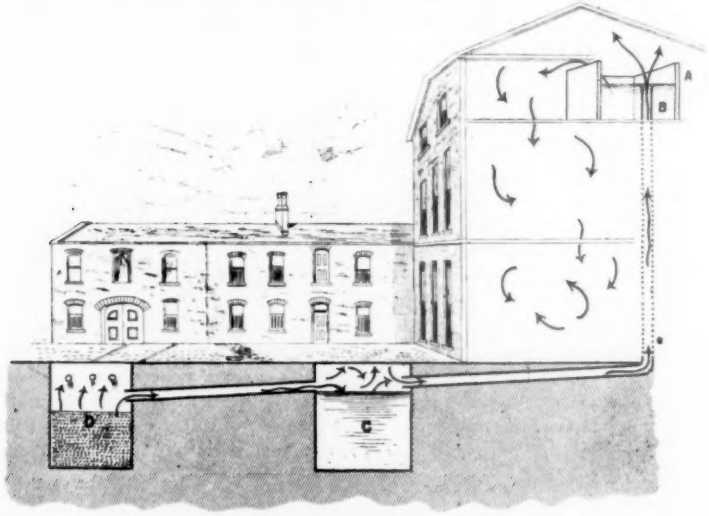
The full value of slow sand filtration, as Simpson's method later came to be known, was not appreciated for many years after 1829. Although introduced with the object of removing visible suspended matter, it does in fact remove particles down to and even beyond the limits of microscopic size, including a very high proportion of bacteria, which are trapped by the slimy film which forms in the top layers of sand. Moreover, the living organisms—bacteria, algæ and protozoa—which form this film thrive on the organic impurities in the water, which they extract, oxidize and return to the water in harmless inorganic forms. Thus a sewage-polluted water, after passing through a properly operated slow sand filter, has lost not only all of its visible dirt, but also more than 99 per cent of any dangerous bacteria it may have contained, and a very large proportion of dissolved impurities which otherwise would cause objectionable tastes and odours, and would encourage further bacterial growth. James Simpson noticed that there was 'an appearance resembling fermentation' when the water was in contact with the sand, but neither he nor anybody else at that time realized the full benefits conferred by the process he had successfully pioneered. The role of water in the transmission of certain diseases was scarcely suspected.

The introduction of pipe sewers for the removal of domestic wastes and the extension and improvement of public water supplies, particularly by sand filtration, were the outstanding contributions of engineering to the improvement of public health during the nineteenth century. It is remarkable that, of these two far-reaching and beneficial reforms, the former was based on a false premise —the miasmatic theory of the spread of disease—and the latter upon a very incomplete knowledge of the processes involved.

THE NATURE OF DISEASE

As the century progressed and scientific thought surged ahead, new light was shed on the nature of disease and its modes of transmission, and it is interesting to consider how the structure of sanitation which had already been built up was, to use an engineering term, underpinned by a new, scientific foundation.

From the earliest times man has speculated on the origin of disease and numerous theories have been put forward, in which angry gods, devils, vapours, bile of various colours, animalcules, climate, soil and many other agents have been held responsible. In the first half of the nineteenth century the generally accepted view was that disease was caused in the first place by noxious vapours arising from decomposing matter, and that it could then be passed from person



How cesspool poison may steal into a country house.

The miasmatic theory of disease transmission. Reproduced from Dangers to Health, *by T. Pridgin Teale, by permission of Messrs. J. and A. Churchill*

to person either by direct contact with morbid matter—for example, from smallpox pustules—or by the inhalation of a sick person's breath. This view was encouraged by the clear evidence that sickness was most prevalent among the poor, living in filthy surroundings such as were described by John Phillips. When cholera arrived in 1831, and returned in 1848, there was, to the uncritical, nothing about its rapid propagation to disprove this miasmatic theory. But a few doctors, studying carefully the circumstances of the cases they had to deal with, found puzzling inconsistencies which did not fit the theory. People went down with cholera who had apparently run no risk, while others, constantly exposed, were not attacked.

In 1848, Dr. John Snow, a native of York practising in London, began to ponder the cause and propagation of cholera. From a consideration of the clinical symptoms he formed the opinion that the disease was caused by a specific poison which entered the alimentary canal directly, since no general symptoms, such as headache or quickened pulse preceded the intestinal derangement, as would happen if the poison were inhaled and entered the bloodstream. Hence the poison was swallowed, not breathed. This led to the further deduction that the poison was excreted from the body and might then be passed on to others through sewage-polluted water or contaminated food, or by contact with the patient, his clothing or bed-linen. In 1849 Snow published his views in a pamphlet, *On the Mode of Communication of Cholera*, and for the next few years availed himself of every opportunity of collecting further evidence. The cholera epidemic of 1854 provided the occasion for the completion of his investigations.

The outbreak of cholera arising from polluted water taken from a pump in Broad Street, London, in September of that year was described by Snow as probably 'the most terrible outbreak of cholera which ever occurred in this kingdom'. Within the area bounded by Regent Street, Oxford Street, Dean Street and Coventry Street, nearly six hundred deaths occurred in a period of two weeks. The number would certainly have been much greater but for two facts. One was the precipitate flight of many of the local population, so that, in Snow's words, 'in less than six days from the commencement of the outbreak the most afflicted streets were deserted by more than three-quarters of their inhabitants'. The other fact was that Dr. Snow, acting on his own theory and his observation that nearly all of the early cases occurred in houses close to the Broad Street pump, persuaded the Board of Guardians to remove the handle of the pump on the eighth day of the outbreak. We cannot be certain of the effect of this measure, since by that time the number of cases occurring daily was already declining, and the original bacterial pollution was presumably dying out. Subsequent investigation, however, showed that the well water had apparently been polluted by leakage from an old brick and stone drain under No. 40, Broad Street, which permitted the excretions of a cholera patient to enter the water. Re-pollution of the well water by the same route might easily have occurred during the course of the outbreak.

Snow's great achievement in the Broad Street outbreak was his careful investigation of the history of individual cases which revealed that nearly every

person affected had drunk water from the pump. No other factor could be found which was common to all or most of the cases. As far as circumstantial evidence can prove anything it proved here that the cholera poison, whatever its exact nature, was transmitted through water polluted by the dejecta of a cholera patient.

As to the nature of the poison, Snow was satisfied from the extent of the damage it was capable of doing that the cholera poison must be able to multiply in the human body. And in the revised and expanded edition of *On the Mode of Communication of Cholera* published in 1855, he said: ' . . . the morbid matter of cholera having the property of reproducing its own kind, must necessarily have some sort of structure, most likely that of a cell'.

He proved to be right. Within the next few decades, Pasteur, Koch and others developed the culture and staining techniques which made it possible to study

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The Broad Street pump outbreak of cholera, September, 1854. Reproduced from Sedgwick's Principles of Sanitary Science and Public Health, *by Prescott and Horwood*

and identify bacteria. Bacteriology had been hovering on the threshold of the scientific world since van Leeuwenhoek first viewed his animalcules through his primitive microscopes two centuries earlier. Fermentations had been observed and speculatively compared with some of the manifestations of disease. Now at last bacteriology became a firmly established science, and important discoveries followed in quick succession.

The early history of bacteriology reads like the last chapter of a detective story, in which mysteries are solved and many puzzling details fall into place. Snow's theory, for instance, was proved in 1884 when Koch isolated the cholera vibrio and showed it to be the specific cause of the disease and transmissible through water. The typhoid organism had already been identified by Eberth in 1880.

Another of our stories had a sequel in 1885, when Professor Percy Frankland started routine bacteriological examination of London's water supplies. In a paper to the Institution of Civil Engineers the following year he reported the first results of this examination, and showed that the number of micro-organisms in the water was reduced by filtration by between 96 and 99 per cent. He was able to relate the efficiency of the treatment given by the various London companies, as measured by the removal of bacteria, to the capacity and method of operation of their plant, and said:

> This coincidence between theory and practice most conclusively proves that in attempting the removal of micro-organisms from water it is no longer necessary to work in the dark, but that the problem is as tangible as the removal of those larger suspended particles which have for long past occupied attention.

Just as bacteriology proved a valuable new tool in the control of waterborne diseases, so other biological sciences helped in other fields. In 1880 Laveran identified the minute animal organism which causes malaria, and in 1897 Ross made his famous discovery of this organism in the stomach of a mosquito. Malaria was proved to be carried by mosquitoes, and at last man knew how to attack it. Engineering methods of water control were soon shown to be an effective means of preventing the breeding of mosquitoes, and in spite of the recent development of insecticides they still have great value.

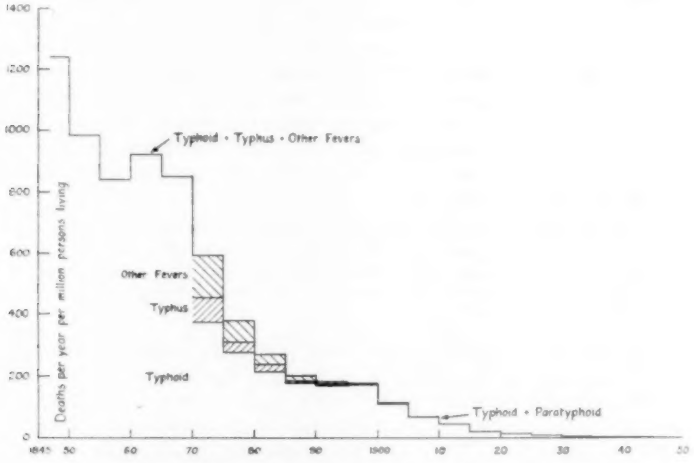
THE ACHIEVEMENTS OF A CENTURY

This review of the progress of sanitary engineering in the nineteenth century has of necessity mentioned only a few of the many developments which took place during this fruitful period. But they are, I think, the most important ones.

By the beginning of the twentieth century, the principles of sanitation were well established and there was a reliable and growing body of information about health and disease on which to work. During the last fifty years the scope has expanded enormously, with a rapid development of new techniques, chemical, biological and engineering. They are far too many to enumerate here, but the cumulative results of a hundred years of sanitation can easily be seen from the official records of disease and mortality.

Since 1866, cholera has been practically unknown in this country, and when introduced has been quickly stamped out. In 1869, when typhoid mortality figures were first distinguished from those due to louse-borne typhus, there were 390 deaths from typhoid among every million persons living in England and Wales. The corresponding figure in 1901 was 155, in 1921 it was 16, and in the last few years it has fallen below one per million.

The logarithmic form of this decline illustrates the statement of the Chief Medical Officer that ' . . . we have now reached the point where further improvement in the physical environment is likely to show diminishing returns. . . .' The incidence of dysentery during the last eighty years has shown a similar decline.



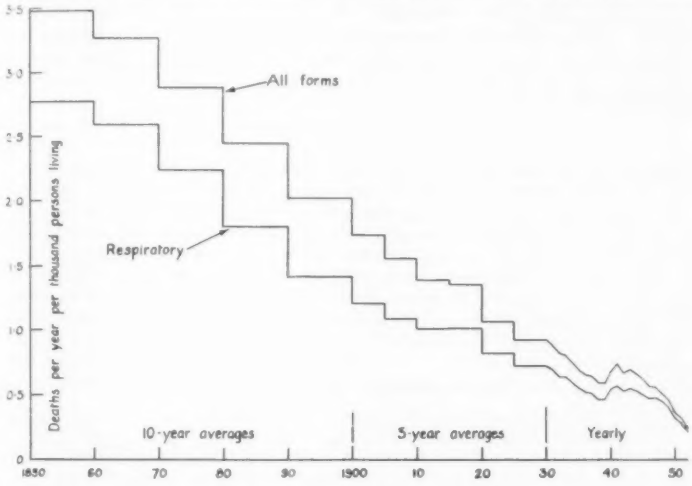
Annual death rates from typhoid, typhus, and other fevers: five-yearly averages, England and Wales, 1857–1950. (From 1847 to 1869 typhoid, typhus, and other ill-defined fevers were not differentiated in official records. The differentiation is shown from 1870 onwards. In the course of time the 'other fevers' became more accurately diagnosed and classified; typhus virtually disappeared from England and Wales by 1910)

Tuberculosis, which thrives under conditions of bad housing, overcrowding and malnutrition, has declined steadily, and the death-rate to-day is less than one-tenth of the death-rate a hundred years ago. Improved diagnosis and treatment, and better food, may be mainly responsible for this reduction, but improvements in housing layout and construction must be given a large share of the credit. Similar considerations apply to rheumatic diseases. Typhus, which caused 4,281 deaths in England and Wales in 1869, is another disease which flourishes only in dirty, insanitary surroundings. It has now disappeared from this country, except for an occasional imported case.

PRESENT AND FUTURE PROBLEMS

The health statistics thus reveal that those diseases which can be most directly attributed to an insanitary environment have been reduced almost to vanishing point compared with the situation a hundred years ago.

Nevertheless I must admit to having misgivings over the use of the phrase 'the end of the era of sanitary engineering'. It is true that the vast bulk of the capital works required to bring about this welcome improvement in the health of the nation has now been installed. But nothing stands still. The population is still growing, and its distribution is constantly changing. Old installations have to be maintained and replaced. Demands are increasing and higher standards



Annual death rates from respiratory and other forms of tuberculosis, England and Wales, 1850–1952

are being set. Although old hazards have disappeared or diminished, new ones arise to take their place—the problems of radioactive wastes, or of the increased incidence of poliomyelitis, for example. Even the pattern of disease changes as some organisms become less virulent and others increase in pathogenic power.

There are more subtle relations between environment and disease still to be explored, such as the influence of living and working conditions on cancer, diseases of the heart and circulatory system, and even influenza and the common cold. Sickness and disability among workpeople, much of it encouraged by faulty working conditions, is responsible for the loss of far more working time than are industrial disputes. A recent survey put the ratio at 270 to 1.

There is much that can be done in the way of environmental control to bring about still further improvements in health—not necessarily to be measured by

reduced death-rates, for we are all mortal, but rather by the reduction of minor and chronic illness, and by improved physique and fitness among all groups of the population.

Engineering applied to this end is truly public health engineering. It is of course by no means a task for the engineer alone. Many of my listeners may have been struck by the fact that I have mentioned by name lawyers, doctors and bacteriologists, but hardly an engineer. That is because I have concentrated on a few of the ideas on which public health engineering is founded, and these have more often than not come from outside the engineering profession. It would have been easy to name a host of engineers who have carried these ideas into practice. But it does emphasize the interdependence of many different sciences in the creation of a healthy environment. It may be the engineer who finally carries out the design and construction; but the skills of many professions necessarily contribute to ensuring that the design is good.

DISCUSSION

MR. J. H. WALTON: I think that Mr. Bruce said that after the fall of the Roman Empire sanitation more or less disappeared until perhaps a hundred years ago. Now I seem to remember reading in Von Boehn's *Modes and Manners* that in fact, after the fall of the Roman Empire, the use of the baths in those towns where the Romans had built them continued for a great while, and poor conditions of sanitation were probably only to be found in the towns built after the fall of the Empire. I think too many people still tend to regard the Middle Ages as the dark ages; I do not think that this is entirely true. The use of the baths went on, and it was not until the discovery of the New World, and the introduction from there of venereal disease, that the baths were shut. The transmission of this disease had been traced to the use and abuse of the baths by so many people. It was then that the real dark ages in sanitation began.

THE LECTURER: I should like to thank Mr. Walton for that addition to my rather bare statements. I cannot claim to be an authority on the Middle Ages, and just when the use of Roman baths was dropped I am not qualified to say, but I am very grateful to him for filling that gap in the story. No doubt he is perfectly right, but I think it is also true that in general, among the vast majority of people in the country, there was very little in the way of sanitation in those days. Only a few people in the towns were able to make use of Roman baths. I think Mr. Walton will agree that nobody else seems to have built baths to continue what the Romans had already done.

MR. D. EYLES: It does seem to me that we have to be careful to differentiate between conditions in centres of civilization such as Knossos and Rome, and those prevailing among rural and nomadic peoples. The lecturer was perhaps a little unfair about the influence of the Church. There were a few fanatics who spoke about dirt not being displeasing, but I think there were just as many clerics who emphasized the need for cleanliness. In fact, to a very large extent, it was the monks who carried on what sanitation there was, and some of the finest examples of medieval sanitation are to be found in the ruins of old monasteries.

I have just one other point on the bath question. The Moors carried on the building of public and private baths for many centuries after the decline of Rome, and they introduced these into Spain. On a smaller scale, there were medieval baths in Germany and other parts of the continent, and one can find many interesting and amusing woodcuts by Dürer and other people which make one realize that bathing did not just disappear.

On the question of the introduction of drainpipes, I think we might recall that there was another man—not an engineer or a doctor or a lawyer, but a potter—who was a distinguished member of the Society and was awarded the Albert Medal in 1885. That was Sir Henry Doulton, who helped Sir Edwin Chadwick a great deal in the development of drainpipes and set up the first special factory in the world to manufacture stoneware drainpipes. The failures referred to by the lecturer were in the common non-vitrified earthenware pipes, and not in the stoneware pipes. I think Sir Henry Doulton did issue a document on that question, begging the engineers of the time not to be led by considerations of cheapness to use these inferior pipes, and he produced statements from many leading engineers in London and Manchester and elsewhere, showing that the vitrified pipes stood up to the necessary conditions.

MR. T. LAW HARRIS: I wonder if some pressure could be brought to bear on the Colonial Office to send out to the Colonies public health engineers as such, and not, as is done now, merely to have a few Colonies sending engineers here for post-graduate training. Now, when they return to the Colony, they are not put on public health engineering jobs, but they are sent on other jobs, and public health engineering comes in *en passant*.

I know a number of Colonies, throughout the British West Indies in particular, where the job of health engineering is left to the medical advisers; there is preventive medicine, quite a lot of clearing of undergrowth, the treating of rivers with certain chemicals, and so on, and yet people are still allowed to build houses under conditions which contribute to the detriment of their health. For instance, I know that a large section of the Indian population on some of the Western Islands still mix their clay with the droppings of cows; those cows are not always tested for tuberculosis and those people sometimes have cut fingers, and outbreaks occur. We thus continue to pour out large sums of money for the rehabilitation and health of those people in the Colonies because we have not sent out several public health engineers as such.

THE LECTURER: I do not think Mr. Harris really expects me to answer him, because I think he knows that I sympathize fully with his point of view and support him entirely. We are training a certain number of engineers from the Colonies, but I am afraid it is outside my scope, and certainly outside the scope of this paper to-day, to discuss what happens to them when they get back to the colonies, but I very much hope they will be used on the sort of work for which they are fitted and trained.

MR. A. F. E. WISE (Building Research Station): I am going to comment on one aspect not dealt with in much detail—that of sanitary services for buildings. I was not altogether surprised to find little reference to this. Many engineers tend to push it into the background for one reason or another. Perhaps the unfortunate word 'plumbing' with its associations is one reason. It may sound such simple stuff, and seem not quite respectable. Nevertheless, it is an essential part of public health engineering and, in fact, the Institution of Sanitary Engineers regards it as such. The Institution's statement of objects refers to conveying and disposing of sewage and refuse, and to raising the standard of environmental hygiene by improved plumbing and drainage. And the objects of the Public Health Engineering Division of the Institution of Civil Engineers include the disposal of domestic and industrial refuse.

The pioneers in the field of sanitary services did well. They abolished the old principle of '*Gardyloo*' and originated soil and waste pipe systems, traps, ventilation pipework, and so on. They provided a safe and efficient means of disposing of human wastes. Unfortunately—dare I say it—there has been little advance since their day. There have been some improvements but, basically, design remains the same. For instance, in spite of some exceptions the general requirement on ventilation

of traps is still protection of each individual trap regardless of its location. The overall cost of continuing this practice is enormous.

There is great scope for development by the sanitary engineer in this field. I can illustrate by referring to work at the Building Research Station. Experiments on soil and waste systems were started about four years ago. We began with simple installations and studied certain basic factors involved. We found that the pressures occurring in the pipework during discharge could be limited by controlling pipe sizes, pipe lengths, and so on, without the need for a ventilation system. The work was then extended to multi-storey installations and it has reached a stage at which recommendations can be made on design for flats. In a typical five-storey block of flats the saving is about 40 per cent for each individual stack pipe installation, and similar opportunities exist in other classes of building.

I should add that this economy is not just a forecast from laboratory study. It has been achieved with installations in a number of blocks of flats in the London area during the last three years. These show a saving and, in addition, they have given better service than some adjacent conventional systems. Aesthetically they can be made easier on the eye, and that too is an advantage.

THE CHAIRMAN: Before thanking Mr. Bruce most sincerely on your behalf for his excellent lecture, I should like to say that I am not too happy that he should have missed out the names of all the engineers who took part in the great public health work which has been carried out during the last hundred years. I suggest that he might have referred to that renowned public health engineer, Sir Robert Rawlinson, who was Superintending Engineer to the General Board of Health in 1848, when the first public health enactments were made in this country. He was a friend of Chadwick and Simon, and one wonders if the professional engineering adviser who was behind their efforts at that time has actually received the credit which was his due. He finished up as Chief Engineer to the Local Government Board, and retired somewhere about 1888. It means that he was the engineering adviser to the Government at the time of the publication of the Public Health Act of 1872. That Act was used by government for something like seventy years, and covered the period during which the greatest strides were made in public health engineering in this country.

I should like to agree with Mr. Bruce when he says that he doubts if the era of public health engineering is passing. In the past this country has been very lucky with its water supplies, but in the last twenty or thirty years, the position has gradually changed. We have already developed nearly all the good upland sources, and we are now seriously over-pumping many of the underground sources. This means in effect that in the future, unless we get recharging of aquifers, or some system of near perpetual motion as applied to water, we may have to use the middle reaches of rivers for our supplies, and then we are up against a host of troubles. We are a small country, and industry is becoming more widespread all the time. It is turning out more and more effluents of a character difficult to treat in sewage treatment work, and although a few of our sewage works are to-day discharging effluents to rivers of a greater bacteriological quality than the waters in the rivers, that position is not general everywhere, and the risk of pollution to our rivers continues to increase. In the years to come it will require never-ending vigilance on the part of the Public Health Engineer, if he is to ensure that diseases such as typhoid and cholera are not to return.

Perhaps I have exceeded my position as Chairman, but I am sure you would like me to thank Mr. Bruce on your behalf for a most excellent and instructive lecture.

The vote of thanks was carried with acclamation; and, another having been accorded to the Chairman, the meeting then ended.

GENERAL NOTES

THE ROYAL ACADEMY SUMMER EXHIBITION

By courtesy of the Royal Academy of Art

Girl in a Blue Armchair *by Edward Le Bas*

Thanks to some progressive members—encouraged, no doubt, by Sir Gerald Kelly who is due to retire from his office after presiding over the next Winter exhibition—the Royal Academy's Summer exhibitions in recent years have taken more account of the rising level of intellectual curiosity of the public than at any previous time in living memory. It will be noticed that once again Galleries VII and VIII have been hung (this year by Mr. Ruskin Spear) with something approaching a token representation of the lively London Group and Young Contemporaries, and had the resources been available it is likely enough that the enterprise would have been extended. In any event, pictures of this quality are by no means confined to the north-east corner; and if one can turn a blind eye to the several tasteless productions—not altogether easy, admittedly, when one is confronted with a sample quite so electrifying as that which dominates Gallery X—there still remains a great deal of thoughtful and deserving work from artists who have mostly won critical respect, in the first place, outside these walls.

A large State portrait of the Queen is hardly a commission that any one of the less conventional artists would have willingly accepted, and in our time perhaps only the youngish Mr. John ever essayed the ceremonial portrait in the grand manner with equal verve and felicity. Mr. Gunn's method excludes verve and, it must be said, any expression of a distinctive personality behind his infinitely painstaking brush. But for sheer technical proficiency, the reproduction of the Coronation gown, robe, and regalia is a *tour de force*, to say the least, and had the likeness been satisfactory his portrait would doubtless have met all popular requirements. There are, of course, other portraits here in this virtually anonymous style; but there are others again which interest one for their qualities of colour, handling, and design—as good pictures, in short, irrespective of the sitters. Such is the picture of a *Girl in a Blue Armchair*, a meditative Gwen John type of sitter, by Mr. Edward Le Bas, or the sketchy yet robust Study by Mr. Robert Buhler, another painter in the Camden Town tradition who models his heads with flakes of broken colour, and has a perceptive eye for character. Mr. Henry Lamb, who shows several carefully worked out portraits here, was actually a member of the Camden Town Group; and in *Souvenir of Brittany, 1910*, he revives, most interestingly, memories of his hard and tense peasants of that period in a version of a mourning family painted in his rather looser style to-day—a work which perhaps inevitably lacks the poignancy of the original.

This year there are, as well, several unusually lively comments on the times, notably those of Mr. Ruskin Spear, who has developed a quasi-expressionist manner and a broader handling well suited to his themes. His *A.D. 1953*, for example, represents several mystified spectators looming round Mr. Reg Butler's prize-winning 'Political Prisoner' model—painted, it might be thought, on an over-large canvas until one reflects that the importance of the occasion was itself exaggerated, and the picture has indeed an appropriate portentousness, with slyness substituted for solemnity. His political *Candidate*, complacently mouthing into a microphone, is, in the same way, instantly arresting; though here there is the acutest characterization of the speaker's supporters shrewdly assessing the reactions of the audience. Mr. James Fitton's comments are, in their way, as tart and pertinent as Mr. Spear's, spiced as they are with a Gallic flavour—his embracing couple, *Sailor's Farewell*, being very typical both of the subtle handling of his paint and of those everyday incidents he delights to depict. One other lively work in a similar vein should be noticed, namely the engaging picture of two children reading 'comics' by a promising student painter, Mr. Peter Blake.

This last painting hangs in Gallery VIII in interesting and varied company too numerous for individual mention. The largest, as it is also among the most conscientious paintings here, is Mr. John Minton's *The Gamblers* at the foot of the Cross, a highly stylized design of radiant colour, admitting only a certain ambiguity in the landscape planes that should lead the eye towards Jerusalem. Hereabouts also is a closely integrated and vivid design of masked dancers by Mr. William Roberts, who sees no reason to depart in any way from an entirely distinctive style he formed years ago; a striking picture of tigers behind bars at Olympia by Mr. Clifford Hall; and other works of quality by Mr. Julian Trevelyan, Miss Stella Steyn, and Mr. L. S. Lowry, whose characteristic urban landscapes make their first appearance in these rooms. Among the water-colours it is good to find Mr. Vivian Pitchforth's impressions of far receding water under the transitory lights of all weathers, and, in an otherwise not particularly remarkable Print Room, several drawings by Mr. Frank Dobson, and Mr. John Skeaping's supple studies of animals in conté crayon.

Besides the work of such established sculptors as Mr. Dobson, Mr. Willi Soukop, and Mr. Siegfried Charoux, whose smaller figures so often seem more directly responsive to his sensibility than statues as towering as his rugged *Fisherman*, there

may also be seen a firmly modelled head by Miss Elisabeth Frink (no doubt the youngest British sculptor represented in the Tate Gallery) and a compact Italianate figure of a *Seated Girl* by Mr. Sydney Harpley, another promising member of the student generation. It is, of course, only by offering increasing evidence of such enterprise that the Royal Academy can ever expect to recapture, in these changed times, something of the authority and influence it enjoyed up to the death of Turner. How earnest its intention is to become, once more, a fully representative and progressive assembly is bound to be reflected in its elections; and here it is a hopeful sign that its recent Associates have included—apart from a nonentity or two—Mr. Basil Spence, the architect-designate of Coventry Cathedral, who has arranged the Architectural room this year, and painters as respected, if not perhaps very commanding, as Mr. Rodney Burn and Mr. John Aldridge. Meanwhile this Summer exhibition deserves to be well attended, the works being conscientiously hung, and the general level of quality seeming a little higher than it was a year ago.

NEVILE WALLIS

PRODUCTION EXHIBITION

The first production exhibition to be held in Britain will take place at Olympia from 7th to 14th July. The British Productivity Council, the Department of Scientific and Industrial Research, the British Standards Institution, and many other government and private organizations will show exhibits illustrating the importance of increased productivity and ways of achieving it. The work of research and its effect when applied in production lines will be shown together with examples of work study, production control, and planning and production methods.

During the exhibition, which will be open daily except Sundays from 10 a.m. to 6 p.m., a conference in which various aspects of production will be discussed will be held.

The admission price to the exhibition is 1*s.* 6*d.*, and special concessions will be made for firms wishing to organize works visits or to send employees or apprentices. Admission tickets to the conference, which cost 1*s.* 6*d.* also, and include admission to the exhibition, can be obtained from the Secretary, the Institution of Production Engineers, 36 Portman Square, W.1.

CARPET DESIGN COMPETITION

Entries are invited by *Furnishing*, the retail furnishing magazine, for their sixteenth annual carpet competition, the object of which is to encourage good contemporary carpet design. Both students and experienced designers may enter for any of the four different sections, in each of which a prize of £10, one of £5, and diplomas will be awarded.

An additional prize of £60 is being offered by the Federation of British Carpet Manufacturers for the best design of the four prize-winning entries.

The closing date for entering the competition is 21st September, 1954. Full details may be obtained from the Editor, *Furnishing*, Drury House, Russell Street, W.C.2.

FROM THE JOURNAL OF 1854

VOLUME II. *12th May*, 1854

From the report of the twenty-first Ordinary Meeting at which a paper On a New Smoke-Consuming and Fuel-Saving Fire-Place, with Accessaries Ensuring the Healthful Warming and Ventilation of Houses *was read by Neil Arnott, M.D., F.R.S. The Chairman, Dr. Lyon Playfair, C.B., said that it was in respect of the almost total*

freedom from smoke that the common household fire of Dr. Arnott would be considered popularly interesting. He continued:

Smoke, like other dirt, had been defined as merely matter in a wrong place. The true place for the products of combustion was to perform a great function as transparent gases in the atmosphere. The habits of civilization increased population rapidly, and an augmented vegetation was required for their support. Now, by the very habits of civilization, the ancient vegetation of former times, now in the form of coal, was exhumed, and, after being used in our fire-places, was again thrown into the atmosphere to promote vegetable growth, required by that population which thus artificially compensated for its own increase. The Chairman stated that he had often thought that we were coming to a time when gas would be to a great extent used for domestic fire-places, and the coke thus formed in large quantities, and offered at a cheaper rate, would be employed for manufacturing purposes, thus producing smokeless fires in both cases. Now, Dr. Arnott's fire-place effected this combined object by one operation. The part of the grate under the bars into which the coal was placed, became, in fact, a gas retort, which gave out a gas that burnt mainly at the top, whilst the coal underneath being now coked, was raised into the fire-place, and also burned without smoke, but with great brightness. The arrangement by which he prevented a large unnecessary draft of air passing up the chimney, whilst it economised fuel, improved the sanitary condition of our rooms, by preventing the dangerous currents of cold air. Besides all these scientific advantages, the fire itself was of a genial home character, and did not run counter to our present prejudices. A witty archbishop had been stated to have defined ladies as creatures who could not reason, and who poked the fire from the top. However untrue the first part of the definition might be, the last certainly coincided with fact, and any fire-place which presented obstacles to the gratification of this propensity would have little chance of succeeding with the superior authorities at our homes. But Dr. Arnott's fire-place in appearance could scarcely be distinguished from those in common use, while it possessed advantages much superior to them.

Some Activities of Other Societies and Organizations

MEETINGS

MON. 17 MAY. Geographical Society, Royal, South Kensington, S.W.7. 5.30 p.m. *Sahara Challenge* (Films).

TUES. 18 MAY. British Architects, Royal Institute of, 66 Portland Place, W.1. 6 p.m. Ian Leslie: *Architectural Criticism.*

Civil Engineers, Institution of, Great George Street, S.W.1. 5.30 p.m. T. J. Upstone and W. Cardno: *Design and Construction of the Superstructure of the Marshal Carmona Bridge at Vila Franca de Xira, Portugal.*

WED. 19 MAY. British Academy, Burlington Gardens, W.1. 5 p.m. Norman Davis: *The Language of the Pastons.*

Folk-Lore Society, at University College, Gower Street, W.C.1. 7.30 p.m. Ralph Merrifield: *Witch Bottles and Magical Jugs.*

Microscopical Society, Royal, Tavistock House South, Tavistock Square, W.C.1. 5.30 p.m. F. C. Smith: *The Double Refracting Interference Microscope.*

Meteorological Society, Royal, 49 Cromwell Road, S.W.7. (1) W. A. Mordy and L. E. Eber: *Observations of Rainfall from Warm Clouds.* (2) T. W. R. East and J. S. Marshall: *Turbulence in Clouds as a Factor in Precipitation.* (3) M. P. Langleben: *The Terminal Velocity of Snow Flakes.*

Petroleum, Institute of, at 26 Portland Place, W.1. 5.30 p.m. S. D. McClean and F. L. Webster: *Medical Services in the Petroleum Industry.*

Sanitary Engineers, Institution of, at Caxton Hall, S.W.1. 6 p.m. *The Report of the Joint Committee on Field Research into Drainage Problems* (Discussion).

Wood Education Society, at the Royal Society of Arts, W.C.2. 7 p.m. T. Marchetti: *About Carpet Design.*

THURS. 20 MAY. Civil Engineers, Institution of, Great George Street, S.W.1. 5.30 p.m. A. W. Christie: *The Road Surface as a Factor in Street Lighting.*

TUES. 25 MAY. Civil Engineers, Institution of, Great George Street, S.W.1. 5.30 p.m. C. R. Westlake, T. A. L. Paton and R. W. Mountain: *Owen Falls, Uganda Hydro-Electric Development.*

WED. 26 MAY. Eugenics Society, at the Royal Society, Burlington House, Piccadilly, W.1. 5.30 p.m. Lord Simon: *Some Aspects of World Population and Food Resources.*

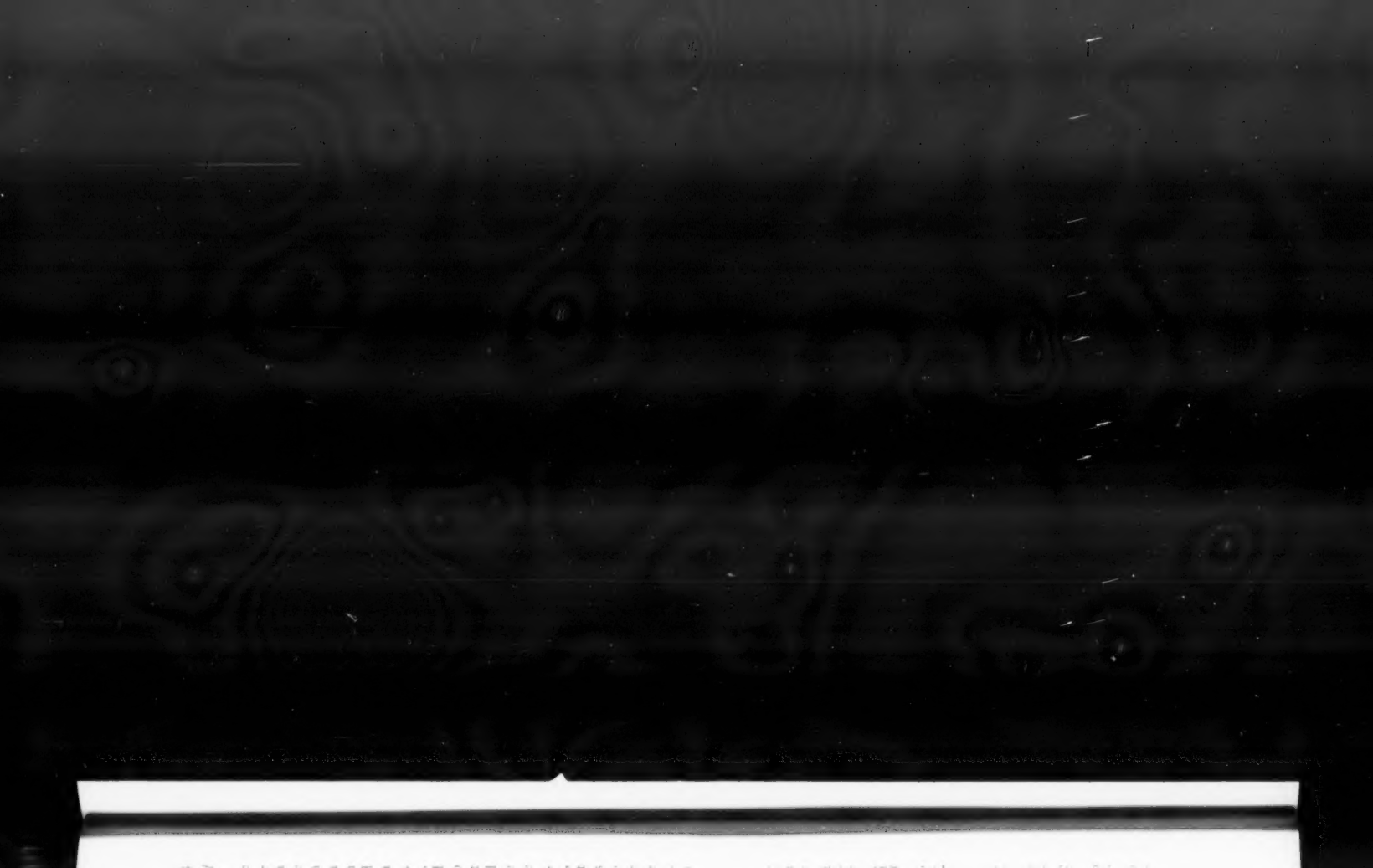
THURS. 27 MAY. Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. J. M. Stock and J. C. Lithgow: *Development and Utilization of Hydro-Electric Power in Uganda.*

OTHER ACTIVITIES

WED. 19 MAY. The Building Centre, 26 Store Street, W.C.1. 12.45 p.m. Film Show: *Timber for Tomorrow.*

SAT. 22 MAY. The Scientific Film Association, at the Royal Society of Arts, W.C.2. 5.30 p.m. Film Show.

WED. 26 MAY. The Building Centre, 26 Store Street, W.C.1. 12.45 p.m. Film Show: *This is Rubber: Rubber in Building.*

NOW UNTIL 20 MAY. British Rumanian Friendship Association, at the Royal Hotel, Woburn Place, W.C.1. Exhibition: *Rumanian Folk Art.*

NOW UNTIL 17 JULY. Sanitary Institute, Royal, at the Museum of Hygiene, 90 Buckingham Palace Road, S.W.1. Exhibition: *Dry Rot and Woodworm.*